The Endogeneity of Optimum Currency Areas Criteria: European Union, Euro zone and the Portuguese Case

João Silvestre *and António Mendonça**

Abstract

Six years after the monetary unification in Europe is still too early to provide a definitive evaluation of its consequences but it is possible to find some evidences. Observing the statistical relationship between business cycles correlation and trade intensity in European Union, Euro zone and the Portuguese economy we conclude that there is, in general, a positive effect that supports the endogeneity argument proposed by Frankel and Rose (1998). However, if we analyse this relation in sub-periods - 1967-1975, 1976-1985, 1986-1992 and 1993-2003 – we conclude that endogeneity hypothesis just hold in the first two, although the correlations are increasing. This could mean that, after Single European Act (1986), other forces beyond trade are contributing to business cycle synchronization. The Portuguese business cycle correlation with European Union and Euro zone had also increased in these four decades, despite the fact that endogeneity hypothesis just hold with a 90% confidence level. In this case, exports seem to be the most important trade flow explaining the economic synchronization. The R^2 of the regressions are very low and, for that reason, we can conclude that even with endogeneity hypothesis confirmed there are other variables explaining business cycles correlation.

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Keywords: Economic and Monetary Union (EMU); Business Cycles Correlation; Optimum Currency Areas; International Trade

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1. Introduction

Six years passed since the beginning of the third phase of Economic and Monetary Union (EMU) in Europe with the official introduction of a single currency. For that reason it is still very early to evaluate completely all its implications. Moreover, the new currency was only physical introduced in 2002 and some of its consequences may present some delay. So, all the conclusions eventually obtained now face serious risks of incompleteness and precocity but are always interesting to observe. All these precautions should be retained for this analysis which results must be considered just a small contribute to the wide evaluation of the EMU effects in European economy.

The main objective of this paper is to perceive if the countries sharing the European single currency are moving to an Optimum Currency Area[1] or, instead, even with all the efforts, if they are moving on the opposite direction. This question is intimately related to the endogeneity of the optimum currency area criteria hypothesis proposed by Frankel and Rose in 1996[2], in a paper published by the National Bureau of Economic Research (NBER). The authors argue that a rise in trade intensity between countries should lead to a wider correlation of their business cycles. If this holds true, the countries will have, therefore, lower needs

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[1] Optimum currency area concept was introduced by Mundell (1961) in a very famous paper. For a revision of the main theoretical support see, for instance, Mongelli (2002) or De Grauwe (2003).

[2] The reference presented in the end of this paper dates back to 1998 because we are considering the publication of the article in The Economic Journal. However, Frankel and Rose first published the text in 1996 as a NBER paper.

of autonomous monetary and exchange rate policies and opens the possibility that optimum currency area criteria could be verified *ex-post* even if they were not gathered *ex-ante*.

Our intention is, precisely, to estimate this relation in European Union, euro zone and evaluate, also, the particular case of the Portuguese economy in order to understand if these countries face a Krugman-type specialization (inter-industry) or an intra-industry specialization. The text is organized as follows: section 2 presents some statistical facts about business cycles correlation in European Union; section 3 introduces the endogeneity hypothesis proposed by Frankel and Rose; section 4 reviews some empirical results about European business cycles and endogeneity hypothesis; section 5 presents the econometric model and the results for European Union and euro zone; section 6 analyzes the Portuguese case; and section 7 concludes.

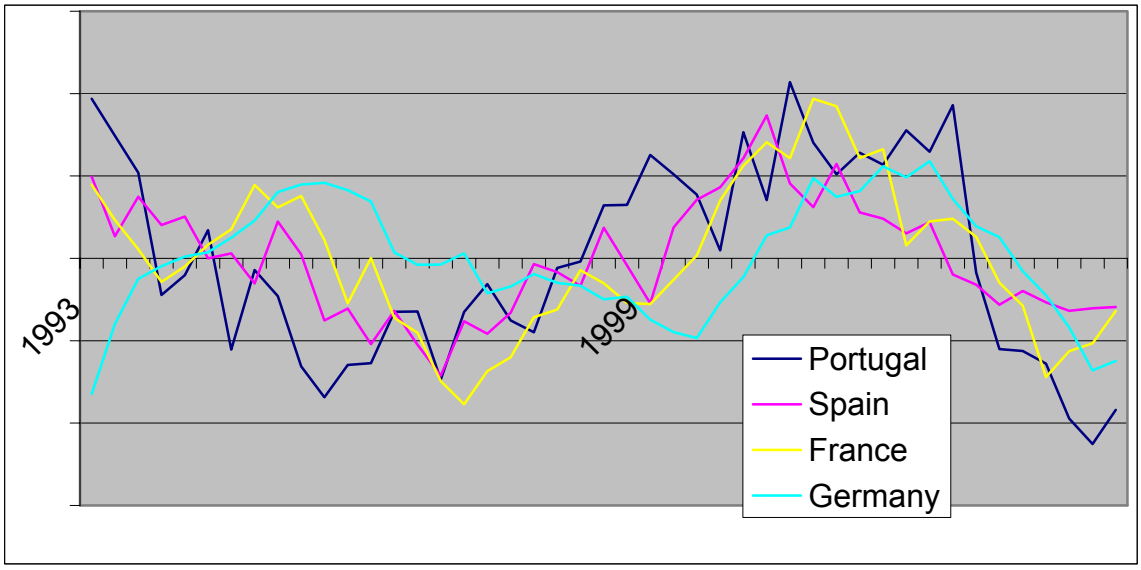
2. Some statistical facts about business cycles correlation in European Union

An informal observation of the OECD quarterly statistics for Gross Domestic Products(GDP) of some European countries between the beginning of 1993 and first quarter of 2004 shows that business cycles are getting more correlated since 1999. Picture 1 depicts Portuguese, Spanish, French and German business cycles extracted with Hodrick-Prescott[3] filter[4].

[3] In section 5 are provided further details about Hodrick-Prescott filter.

[4] Some descriptive statistics for the sample used in econometric model will be presented in section 5.

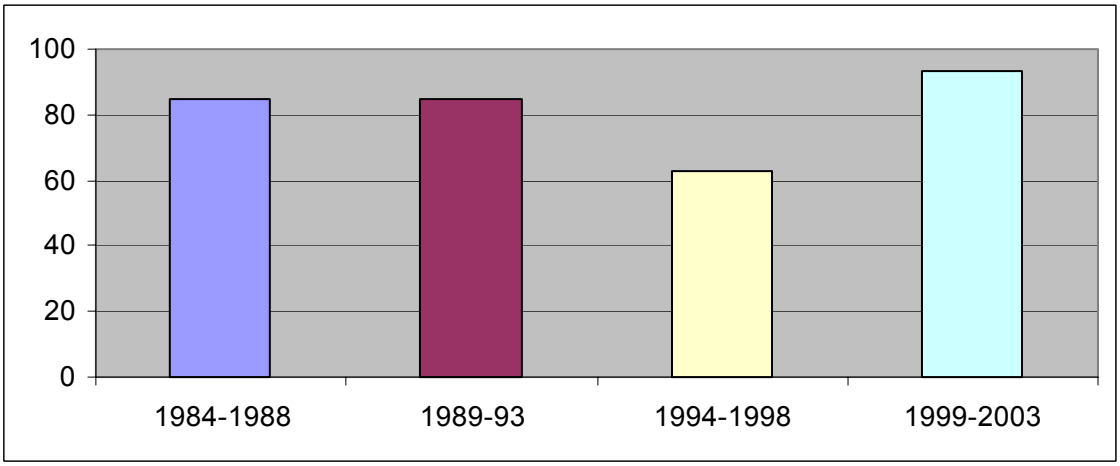
Picture 1 – Business cycles detrended with H-P filter (1993 -2004)



Source: OECD; own calculations

A report published last year, by the European Commission (2004), shows that the cyclical correlation has increased in the euro zone. Picture 2 shows the evolution of the average correlation between the individual countries cycles and the euro zone cycle in percentage[5].

Picture 2 – Cyclical correlation in euro zone (%)



Source: European Commission (2004)

[5] The Commission does not considered Portugal, Greece, Luxembourg and Ireland due to statistical insufficiency.

It can be seen that, although the correlation coefficient diminished significantly in the period 1994 – 1998, from 85% to 63%, it increases again after 1999 – the year of the physical introduction of the single currency – to 93%.

3. The endogeneity of optimum currency area criteria hypothesis

Many authors defend the creation of a monetary union can lead the participant countries to an optimum currency area. This argument was first introduced by Frankel and Rose (1998) and has been broadly discussed since then. These authors argue that an increase in trade integration can produce tighter business cycles correlation and, consequently, a smaller needing for monetary independence. This conclusion is the opposite of inter-industry specialization hypothesis argued by Paul Krugman (1993). With this paper Frankel and Rose opened a wide debate about optimum currency areas and their defining criteria, arguing that the introduction of a single currency in a particular region can help to reach the criteria *ex-post,* even if they were not verified *ex-ante*. They analyze the business cycles and trade intensities of twenty industrialized countries, between 1959 and 1993, and found a positive statistical relation between these two criteria, normally considered the more important to define an optimum currency area. They say, this is just an application of the famous "Lucas Critique" (Lucas, 1976) to the analysis of optimum currency areas, in which framework the business cycles correlation is endogenous regarding trade between States in result of both criteria being affected by policies. Intuitively, this means that the business cycles of the countries that participate in a monetary union are affected, after the integration, by a centralized monetary policy but also by an increase of their trade flows. This relation between trade intensity and business cycles correlation, in a theoretical framework, can assume positive or negative signs. If the case

is an inter-industry specialization based on comparative advantages, as Krugman (1993) or Kenen (1969) argue, then cycles tend to be less symmetrical and the coefficient shall be negative. In the opposite way, if the specialization process is mainly intra-industry, i.e. if the bulk of the trade flows are within the same sector, then the cycles will be more correlated and the coefficient is positive. This is the view of the European Commission (1992) that gave theoretical support to the Economic and Monetary Union project in Europe.

Despite the obvious influence of specialization pattern on business cycles correlation, many other factors play in fact an important role in idiosyncratic shocks transmission across monetary union members. An increase in public expenditure or private investment within a specific country has consequences not only at the domestic economy level but also at the level of the economies with higher degrees of economic integration.

The eventual benefit arisen from business cycle correlation, as result of an increase in trade intensity, is still reinforced by the fact the participation in a monetary union is also a catalyst for trade between members. This is known as "Rose Effect" (Rose, 2000), because this author was the first to estimate it. Since Rose, many other empirical studies show a positive relation between the sharing of a common currency and trade flows. The estimates range from very low values to 376%[6].

4. Previous empirical results

Business cycles correlation has been empirical tested several times. The two main criteria to evaluate *ex-ante* the monetary integration success had motivated many works with different methodologies and data samples. One of the most used methods to measure business cycles

[6] Rose (2004) provides an extensive review of these results.

symmetry is VAR methodology developed by Blanchard and Quah (1989). With VAR model, Bayoumi and Eichengreen (1993) concluded that European shock asymmetry was larger than in the U.S.A. and, because of that, the adoption of a single currency would be a risk. De Grauwe and Vanhaverbeke (1993) concluded that the idiosyncratic shocks tend to be more persistent between regions inside the same country than between European countries. Artis and Zhang (1997) showed that exists a common cycle in Europe as predicted by the endogeneity hypothesis. Kenen (2000) argued, however, that business cycles correlation can happen in consequence of the trade integration but that does not means that shocks symmetry itself needs to decrease. According to the author, the monetary unions affect the shock transmission mechanism but not its incidence. Related to this argument, Hughes Hallet and Piscitelli (1999) showed that a monetary union can accelerate the cycles convergence but only when a sufficient symmetry in the monetary transmission exists, namely through prices and salaries.

Fridmuc (1999) tested the endogeneity hypothesis with a regression similar to the originally proposed by Frankel and Rose but including a structural variable – intra-industry trade – and concluded that there is a positive relation between this variable and business cycles correlation. So, because intra-industry trade is positively related to bilateral trade intensity, the endogeneity hypothesis holds. But the estimates pointed to a Krugman-type specialization process.

Giancarlo Corsetti and Paolo Pesenti (2002) show, theoretically, that a monetary union could become optimum *ex-post* even without an intra-industry specialization process. According to these two authors, this situation occurs as a result of the authorities´ commitment and agent's reaction, in price setting, that transforms the fixed exchange rates optimal in a self-validating way.

More recently, Artis (2003) concluded that cannot be found a European business cycle and, although some countries present large synchronizations, others are inclusively nearer to the USA or Japanese economies due to globalisation. Babetski (2004) studied Enlargement countries and verified that trade integration leads, in general, to a wider symmetry of the demand shocks but, in supply shocks, it depends on the country considered. He concluded also that a reduction in exchange rate volatility have a positive effect in demand shocks convergence and, at least in what concerns to these shocks, confirms the endogeneity hypothesis.

5. Econometric model

Now, we are going to evaluate the relation between the cycles symmetry and trade intensity in European Union. Obviously, many other others factors beyond bilateral trade intensity play a role in cycles synchronization and in shock incidence or transmission, but the objective of this analysis is only to evaluate the trade effect and not trying to find all the explanatory variables of business cycles correlation. In fact, though the statistical significance of the model, it has reduced explanatory power and R^2 of the regressions are very low.

The econometric analysis is based on GDP and bilateral imports/exports annual data collected from Chelem Database for 14 countries of the European Union[7] in the period 1967-2003. The model follows the originally proposed by Frankel and Rose:

$$Corr(Q_i, Q_j) = \alpha + \beta \ln(IC_{ij}) + \upsilon_{ij}$$

i.e., business cycles correlation ($Corr(Q_i, Q_j)$) - is used the annual GDP between 1967 and 2003 - is explained as a function of the natural

[7] Chelem Database has aggregate trade statistics to Belgium and Luxembourg.

logarithm of bilateral trade intensity ($\ln(IC_{ij})$). The trade intensity is defined in three distinct forms: exports, imports and total trade. υ_{ij} is a random error term.

Business cycles correlation is measured by bilateral correlation coefficient of economic activity cycles obtained from the GDP statistics with Hodrick-Prescott[8] filter. For trade intensities we considered the following three ratios:

. Exports $$TIx_{ijt} = \frac{X_{ijt}}{X_{it} + X_{jt}}$$

. Imports $$T\,\mathrm{Im}_{ijt} = \frac{M_{ijt}}{M_{it} + M_{jt}}$$

. Total Trade $$TIt_{ijt} = \frac{X_{ijt} + M_{ijt}}{X_{it} + X_{jt} + M_{it} + M_{jt}}$$

TIx_{ijt} is bilateral trade intensity between the country i and the country j in moment t measured by exports. $T\,\mathrm{Im}_{ijt}$ and TIt_{ijt} represent trade intensity measured by imports and total trade. X_{it}, X_{jt}, M_{it} and M_{jt} are, respectively, the total exports of the countries i and j at moment t and the total imports of the countries i and j at moment t. X_{ijt} and M_{ijt} are the exports from country i to country j and the imports from country j to country i at moment t.

[8] Hodrick, R. and Prescott, E. (1980). Filters are used, and H-P is only the most common between several others, to extract the cyclical component from the series. This it is obtained solving the following minimization problem in order to x^*_t:

$$\underset{x^*_t}{Min} \sum_{t=1}^{T} (x_t - x^*_t)^2 + \lambda \sum_{t=1}^{T} ((x^*_{t+1} - x^*_t) - (x^*_t - x^*_{t-1}))^2$$

To estimate the equation, sample was splat in four sub-samples - 1967-1977, 1977-1985, 1986-1992 and 1993-2003. Trade intensity was calculated for each one of the four periods from the annual data and we obtain four values for each pair of countries (twelve if we consider exports, imports and total trade).

For the GDP data we extracted the cycle from the series (in logarithms) using the Hodrick-Prescott filter with λ= 100, as usual for annual data, and calculated bilateral correlation coefficient in the four sub-periods. Due to endogenously[9], namely the fact that trade is also dependent on monetary arrangements, we use ordinary least squares (OLS) but also instrumental variables estimation (2SLS - two-stages least squares). In the latter, trade intensity was estimated with a gravity model and the regressions were carried out with these fitted values. For the gravity equation[10] we consider three explanatory variables that are very usual in this kind of models: distance (in logarithm), the existence of a common border and the share of a common language. The last two variables are dummy variables that assume value 1 when the condition is verified - border or common language - and 0 when these conditions are not verified. We conclude, however, that in certain cases some of these dummy variables were not statistically significant and, in those situations, we take them out of the model.

The estimates confirm a positive relation between bilateral trade intensity and business cycles correlation in European countries. All the equations were estimated for the fifteen countries of the European Union, and also for the twelve participating in EMU[11]. In general, independently of the trade indicator used to compute bilateral trade

[9] Exogenous variables are correlated with random error term.
[10] Rose (2000) presents a revision of gravity models literature.
[11] United Kingdom, Denmark and Sweden are not in EMU. Euro zone: Portugal, Spain, France, Belgium, Luxembourg, Holland, Germany, Austria, Italy, Greece, Finland and Ireland.

intensity – exports, imports or total trade –, the results confirm the Frankel and Rose argument and suggest an intra-industry specialization profile.

First we present some descriptive statistics about business cycles correlation.

5.1 Descriptive statistics

A brief look to the business cycles descriptive statistics give immediately the idea that, in European Union, economies are more synchronized now than four decades ago. Table 1 presents the average correlation in European Union and euro zone.

Table 1 – Average business cycles correlation

	1967-1975	1976-1985	1986-1992	1993-2003	Whole sample (1967-2003)
European Union	0,38	0,4	0,47	0,6	0,47
Euro zone	0,4	0,54	0,63	0,56	0,53

As we can see, business cycles correlation in European had increased progressively in this period, with coefficient growing from 0,38 in 1967-1975 to 0,6 in the last period. On the contrary, correlation in euro zone presented some oscillations. After an increase from 0,4 to 0,63 in the first two periods, the average business cycles correlation in euro zone diminished to 0,56 between 1993-2003. If we remember Picture 2 presented in section 1, this is surely due to a decrease in correlation between 1993 and 1998. Many possible explanations could be proposed but this behaviour is probably related to some last minute efforts to accomplish the convergence criteria that take some business cycles out of their normal path.

For Portugal, despite the lower sample dimension, we find that average business cycles correlation with European Union and Euro zone grew rapidly in these four decades. The statistics are presented in table 2.

Table 2 – Portuguese average correlation with European Union and Euro zone

	1967-1985	1986-2003	Whole sample (1967-2003)
European Union	0,44	0,68	0,56
Euro zone	0,54	0,73	0,64

Average correlation between Portuguese business cycle and euro zone economies business cycles increased from 0,54 to 0,73, while with European Union business cycles grew from 0,44 to 0,68. We see, therefore, a great advance in business cycles correlation that has a most dramatic evolution after the Portuguese admission to European Community in 1986, as it could be expectable.

5.2 OLS Estimation for European Union

In Table 3 are compiled the OLS estimation results for European Union. The estimated coefficients confirm that exists, in fact, a positive relation between the business cycles correlation and trade intensity in these fifteen countries[12]. This result supports the endogeneity hypothesis presented by Frankel and Rose and suggests that business cycles are becoming more synchronized.

[12] We are considering the fifteen European countries before last enlargement.

Looking to Table 3, we see that the estimated coefficients were 0,08, 0,04 and 0,07, respectively for the trade intensity computed with the logarithms of the exports, imports and total trade.

Table 3 – OLS estimates for European Union (1967 – 2003)

	TRADE INTENSITY		
	log exports	**log imports**	**log total trade**
Business cycles correlation	0,0850874 (0,000)	0,0476827 (0,005)	0,0740333 (0,000)
R^2	0,0510	0,0212	0,0387

Note: P-values in brackets. **(N= 364*)***

In all cases R^2 is very low, showing the limited explanatory power of the model and the absence of other determinant variables for business cycles correlation. That was not, however, the goal of this analysis that intended only to find the relation between these two variables and try to evaluate the endogeneity hypothesis in euro zone and European Union.

The low R^2 obtained are probably related with the fact that, in certain sub-periods, bilateral trade intensity is not statistically significant to explain the business cycles correlation. Doing the same regression for each one of the four sub-samples we find that, in fact, only in periods 1967-1976 and 1977-1985 is possible to consider trade intensity as a determinant factor of economic synchronization. On the contrary, in periods 1986-1992 and 1993-2003 trade intensity is not statistically relevant considering the t-tests. In Tables 4, 5, 6 and 7 are presented the results of these four regressions.

Table 4 – OLS estimates for period 1967-1976

	TRADE INTENSITY		
	log exports	log imports	log total

			trade
Business Cycles correlation	0,1265383 (0,000)	0,708753 (0,006)	0,1117887 (0,000)
R^2	0,2145	0,0827	0,1573

Note: P-values in brackets. **(N =*91)***

Table 5 – OLS estimates for period 1977-1985

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,1470666 (0,001)	0,0663801 (0,075)	0,1145407 (0,006)
R^2	0,1267	0,0352	0,0814

Note: *P-values in brackets.* **(N=*91)**

Table 6 – OLS estimates for period 1986-1992

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,001498 (0,975)	-0,0182104 (0,668)	-0,0046582 (0,922)
R^2	0,0000	0,0021	0,0001

Note: *P-values in brackets.* **(N=*91)**

Table 7 – OLS estimates for period 1993-2003

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,0047058 (0,9000)	0,276749 (0,367)	0,0166908 (0,383)
R^2	0,0002	0,0092	0,0023

Note: *P-values in brackets.* **(N=*91*)**

These results show a bigger R^2 in the first two periods than the obtained for whole sample and for the two last periods. Since 1986 trade intensity does not seem to have any influence in business cycles correlation. This situation must be related with other different forces of cycles´ synchronization, like Single European Act, Maastricht Treaty, convergence criteria, among others. Probably, trade intensity is a very important factor of business cycles correlation just when there are not other factors of interdependence and countries pursue totally independent economic policies.

5.3 OLS Estimation for Euro zone

For the twelve countries of Euro zone the results go in the same direction. In Table 8 are reported the results. The estimated β´s were 0,09, 0,06 and 0,08, respectively for the exports, imports and total trade.

Table 8 – OLS estimates for Euro zone (1967 – 2003)

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,0909179 (0,000)	0,0590074 (0,002)	0,0832918 (0,000)

R^2	0,0775	0,0419	0,0648

Note: *P-values in brackets.* **(N=*220*)**

Like in the European Union case, trade intensity is not statistically significant as explanatory variable of the business cycles correlation in euro zone since 1986. In Tables 9, 10, 11 and 12 are presented the results for each one of the four sub-periods. Once again, the R^2 in periods 1967-1976 and 1977-1985 are above of the obtained for the complete sample.

Table 9 - OLS estimates for period 1967-1976

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,1515852 (0,000)	0,1101421 (0,001)	0,1472965 (0,000)
R^2	0,3296	0,2020	0,2903

Note: *P-values in brackets.* **(N=*55*)**

Table 10 - OLS estimates for period 1977-1985

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,1481579 (0,003)	0,0875327 (0,049)	0,1254134 (0,011)
R^2	0,1545	0,0712	0,116

Note: *P-values in brackets.* **(N=*55*)**

Table 11 - OLS estimates for period 1986-1992

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,001206 (0,998)	-0,0276476 (0,486)	-0,127439 (0,773)
R^2	0,0000	0,0092	0,0016

Note: *P-values in brackets.* **(N=*55*)**

Table 12 - OLS estimates for period 1993-2003

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,0069674 (0,881)	0,0121927 (0,754)	0,0114622 (0,806)
R^2	0,0004	0,0019	0,0011

Note: *P-values in brackets.* **(N=*55*)**

5.4 Instrumental variables estimation (2SLS)

Due to endogeneity between trade intensity and the error term, the same equation was estimated using instrumental variables[13]. As we said previously, we used three variables – common border, common language and logarithm of the distance – to estimate bilateral trade intensities. In some cases, one or another of these variables were not statistical significant and we take them out the model.

[13] We make Hausman tests that confirmed the endogeneity hypothesis and suggested the use of 2SLS estimation.

Table 13 presents the results with instrumental variables for the fifteen countries of the European Union. Like OLS estimates presented earlier, these confirm the existence of a positive relation between trade intensity and business cycles correlation. Estimated coefficients were 0,09, 0,07 and 0,08, respectively, for exports, imports and total trade.

Table 13 – 2SLS estimates for European Union (1967 – 2003)

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,0859178 (0,002)	0,0687854 (0,003)	0,0795043 (0,002)

Note: *P-values in brackets.* **(N=*364*)**

In table 12 are the results of 2SLS estimation for euro zone. The estimated β´s validate the endogeneity hypothesis and suggest an intra-industry specialization process that is contributing to business cycles correlation.

Table 14 – 2SLS estimates for euro zone (1967 – 2003)

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,0898417 (0,003)	0,0718043 (0,004)	0,0791956 (0,004)

Note: *P-values in brackets.* **(N=*220*)**

For euro zone countries, estimated coefficients are above the results obtained for the European Union, with values of 0,09, 0,07 and 0,08,

respectively, exports, imports and total trade. We do not present R^2 because with 2SLS estimation they are not valid.

Dividing the sample in the four sub-periods considered, we confirm the conclusions of OLS estimation. As we can see in Tables 15, 16, 17 and 18 for European Union and euro zone, based on t-statistic, the estimated coefficients are only statistically significant in the two first periods.

Table 15 – 2SLS estimates for period 1967-1976

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation (European Union)	0,115622 (0,004)	0,0994344 (0,008)	0,1105883 (0,005)
Business cycles correlation (euro zone)	0,112851 (0,012)	0,98615 (0,018)	0,1088313 (0,014)

Note: *P-values in brackets.* **(N=91; N=55*)***

Table 16 – 2SLS estimates for period 1977-1985

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation (European Union)	0,1583925 (0,005)	0,1338523 (0,008)	0,1479528 (0,006)
Business cycles correlation (euro zone)	0,1590668 (0,014)	0,1337221 (0,018)	0,1479682 (0,014)

Note: *P-values in brackets.* **(N=91; N=55*)***

Table 17 – 2SLS estimates for period 1986-1992

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation (European Union)	0,0082661 (0,901)	0,0027394 (0,936)	0,0049801 (0,936)
Business cycles correlation (euro zone)	0,0321056 (0,533)	0,0280659 (0,57)	0,0311374 (0,576)

Note: *P-values in brackets.* **(N=91; N=55*)***

Table 18 – 2SLS estimates for period 1993-2003

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation (European Union)	0,0496527 (0,347)	0,0420904 (0,287)	0,0476901 (0,312)
Business cycles correlation (euro zone)	0,0429628 (0,511)	0,0355824 (0,466)	0,411581 (0,479)

Note: *P-values in brackets.* **(N=91; N=55*)***

6. The Portuguese case

Applying the same model to the Portuguese economy we did not find very satisfactory results. In his big majority, the estimates are not statistically significant at 95% confidence level, and only if we consider a 90% confidence level is possible to obtain significant estimates and, in those cases, the endogeneity hypothesis is validated.

In table 19 are represented the OLS results for Portugal with the fifteen countries of European Union before the last Enlargement. Estimated coefficients were 0,1, -0,01 and 0,07, respectively for the exports, imports and total trade. The estimated β for trade intensity measured from the imports assumes a negative value but is not, however, statistically significant. The coefficients of trade intensity based in exports and total trade are statistically significant only if we consider a 90% confidence level.

Table 19 - OLS estimates for Portugal and European Union (1967 - 2003)

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,1054562 (0,079)	-0,0099266 (0,895)	0,0718277 (0,061)
R^2	0,0603	0,0399	0,0682

Note: *P-values in brackets.* **(N=52)**

The same happens when is evaluated the endogeneity hypothesis between Portugal and the other eleven countries of EMU, as is represented in table 20. In this situation, even with a 90% confidence level, only the regression that uses trade intensity computed from exports is statistically significant.

Table 20 - OLS estimates for Portugal and Euro zone (1967 - 2003)

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,0930788 (0,053)	0,0647652 (0,361)	0,0387696 (0,237)
R^2	0,0951	0,022	0,0365

Note: *P-values in brackets.* **(N=*40*)**

Using estimation 2SLS the conclusions are similar. In table 21 are represented the estimates for Portugal and European Union that show that, even with a 90% confidence level, only the trade intensity calculated from exports and total trade are statistically significant.

Table 21 – 2SLS estimates for Portugal and European Union (1967 – 2003)

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,1421704 (0,066)	0,3187752 (0,126)	0,0791956 (0,004)

Note: *P-values in brackets.* **(N=*52*)**

If we consider only the euro zone is not possible obtain statistically significant estimates with instrumental variables. As we can see in Table 22, the three estimates have *p-values* over 5% and even over 10%.

Table 22 – 2SLS estimates for Portugal and Euro zone (1967 – 2003)

	TRADE INTENSITY		
	log exports	log imports	log total trade
Business cycles correlation	0,0893422 (0,128)	0,1714856 (0,158)	0,1131918 (0,166)

Note: *P-values in brackets.* **(N=*40*)**

The regressions carried out for the particular case of Portuguese economy validate the endogeneity hypothesis proposed by Frankel and Rose in some cases. This only happens with a confidence level of 90%. Using the most usual confidence level – 95% – none the estimated coefficients for the Portuguese economy are statistically significant. This

situation could be explained by low sample dimension. Like in the other regressions previously presented for European Union and euro zone, trade intensity looks to have a low influence in business cycles correlation of Portuguese economy, tough this relation tends to be positive.

7. Conclusion

Based on the econometric analysis presented, we conclude that trade intensity has a positive effect in business cycles correlation in European Union. A result that give some support to the endogeneity hypothesis defended by Frankel and Rose and to the idea that trade flows are helping the European Union to move to an optimum currency area. These results also suggest that specialization process in Europe has been mainly intra-industry type. Nevertheless, these results only support the endogeneity hypothesis if we consider the whole sample. If we divide the sample in four sub-periods and make the same regressions OLS e 2SLS, we find a very interesting fact. In the two first periods – 1967-1975 and 1976-1985 – trade intensity is statistically significant as an explanatory variable of the bilateral business cycles correlation and presents a R^2 above the obtained for the complete sample. On the contrary, in the two last sub-periods – 1986-1992 and 1993-2003 – the trade intensity is not statistically significant. This is true with any of the indicator used to measure the bilateral trade intensity – exports, imports and total trade – and whether we consider the fifteen countries of European Union or only the euro zone.

These estimates for the sub-samples help to explain the reason why the regressions for the whole sample present very low R^2. Probably since 1986 other factors are explaining the business cycles correlation. This empirical observation make some sense, intuitively, if we think that the

political coordination and economic integration of last two decades had created many other factors of interdependence beyond trade.

In Portuguese economy, despite some not statistical significant estimates with a 95% confidence level, is possible to obtain significant estimates with a 90% level that confirm the conclusions regarding the euro zone and European Union.

The verification of endogeneity hypothesis, as suggested by Frankel and Rose, in the European Union and euro zone in period 1967-2003, do not necessary means that others important explaining factors of business cycles correlation can be neglected. Mainly because the analysis of the estimates in the four sub-periods suggests that, since 1986, the endogeneity is not verified. This permits to conclude that since that date – that corresponds to the year of the Single European Act – other factors are determining business cycles synchronization in European Union. Probably, synchronization is more the result of economic integration efforts and policy coordination in these two decades and, specially, the result of the Stability and Growth Pact restrictions in the last one.

All the regressions were also made with trade absolute values instead of logarithms and with PPP GDP that confirmed the conclusions. However, it is necessary to recognize that, in one hand, it is still too early to evaluate definitely these relations and, on the other hand, we are considering a very long period. It would be interesting to test endogeneity with other data – eventually monthly or quarterly – in last ten years that corresponds to the period since the signature of the Maastricht Treaty and the preparation of EMU. The fundamental difficulty is to obtain monthly or quarterly trade data.

By all these reasons, the results must be looked with attention and interest but also with all the precautions these issues require.

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